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RESEARCH PROJECT INITIATION

Date: 12 April 1974

Project Title: Student Science Training for High Ability Secondary School Students

Project No: E-27-519

Principal Investigator Dr. John L. Lundberg

Sponsor: National Science Foundation

Agreement Period: From 3-15-74 Until 10-31-74 (Grant Period)

Type Agreement: Grant No. GY-11387

Amount: $11,430

Reports Required: Student Participant Information Sheets; Director's Final Report; Grant Fiscal Report.

Sponsor Contact Person (s):

Dr. Max Ward
Program Manager
Student-Oriented Program
National Science Foundation
Washington 20550
Phone: (202) 282-7900

Assigned to: School of Textile Engineering

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RA-3 (6-71)

GEORGIA INSTITUTE OF TECHNOLOGY
Office of Contract Administration

SPONSORED PROJECT TERMINATION

Posted
OCA

Date: March 13, 1976

Project Title: Student Science Training for High Ability Secondary School Students

Project No: E-27-519

ject Director: Dr. John L. Lundberg

nsor: National Science Foundation

ective Termination Date: 10/31/74

arance of Accounting Charges: 10/31/74

nt/Contract Closeout Actions Remaining: None

- __ Final Invoice and Closing Documents
- __ Final Fiscal Report
- __ Final Report of Inventions
- __ Govt. Property Inventory & Related Certificate
- __ Classified Material Certificate
- __ Other_____

signed to: Textile Engineering (School/Laboratory)

pies to:

Project Director
Division Chief (EES)
School/Laboratory Director
Dean/Director-EES
Accounting Office
Procurement Office
Security Coordinator (OCA) ✓
Reports Coordinator (OCA)

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EES Information Office
Project File (OCA)
Project Code (GTRI)
Other_____

CA-4(3/76)

E27-579

FINAL REPORT

1974 National Science Foundation Student Training Program in Polymer, Fiber & Textile Science & Engineering at the Georgia Institute of Technology

June 17 - August 2, 1974

-Abstract-

Thirty-eight students from 27 high schools in 4 states and Puerto Rico worked on 33 research projects, with 20 research advisors, on polymers, fibers, and textiles and in other areas of science and engineering. Good, meaningful data were obtained in at least 20 projects; results of several of the projects will be published as continuing studies are completed.

All students attended 45 seminars and demonstrations in which science, engineering, and mathematics were taught without separation into traditional disciplines. Polymers, fibers and textiles were emphasized. All students attended 8 colloquia with speakers from off-campus or other schools at Georgia Tech; 2 two-hour visits and seminars on computers, computing, and plotting; 3 off-campus visits on field trips; 6 on-campus visits to facilities and other schools; and 3 research conferences to report on their work. In addition, if students so desired they could attend 12 seminars on thermodynamics, quantum mechanics, statistical thermodynamics, and scattering; 4 two-hour seminars on computer programming and plotting; and 16 showings of more than 25 motion pictures on science and technology. Ten (10) recreational group activities were enjoyed by the group.

Study of topics in science, engineering, and mathematics without separation into subjects or disciplines is effective. Students benefitted from the diversity of research opportunities offered, unstructured work with much individual attention, catholic definition and treatment of sciences, and widely varied activities. The necessity to choose continually among many alternatives in academic and extracurricular activities on campus was a particularly valuable experience for these students whose experiences have been limited to rather rigidly structured schools offering few choices.

Submitted by:

John L. Lundberg
NSP-SSTP Director
School of Textile Engineering
Georgia Institute of Technology

Table of Contents

Final Report: 1974 NSF-SSTP, Georgia Tech, June 17 - August 2

I. Preparation

A. Advertising the program

The School of Textile Engineering prepared two brochures (Appendix I), one with no mention of the National Science Foundation for distribution before awards of grants were announced. These were distributed to all principals, counselors, and teachers of sciences and mathematics in secondary schools in the public school systems in metropolitan Atlanta and to principals of all high schools, teachers of science listed as such with the Georgia Education Association, and members of the Science Teachers Association throughout Georgia. Mr. Dallas Stewart, Science Coordinator, Education Department, State of Georgia, has been most helpful in 1973 and 1974 in helping us to contact teachers and school officials. Brochures and descriptive information about the program were sent to science teachers and area resource coordinators (in Georgia and nearby states) with whom we are acquainted. Brochures were sent to administrative offices of principal school districts throughout the Southeast.

We adverstised our program at science fairs, group meetings of high school students and/or teachers, etc. An article appeared in the Georgia Science Teachers Association publication. A second brochure, mentioning support by the Foundation, was distributed to many of the science teachers in Georgia.

Mr. A.J. Maguire, III, who works as a recruiter of and advisor to incoming students in the School of Textile Engineering, interviewed several prospective participants, including a few of those who did participate, in his visits to high schools in Georgia.

B. Selecting Students

A few hundred students and teachers inquired about the program. Forty-four (44) students submitted applications. Of these, forty-two (42) completed their applications and were accepted. One student declined our in-

vitation and attended an NSF-SST program closer to her home (in Texas). One applicant's parents would not permit her to live away from home during the summer. We could not arrange transportation for one applicant from American Samoa. Thirty-nine (39) students participated in the program. One (1) student left the program after the first week to participate in a student program at a local hospital. Thirty-eight (38) students participated in the program in its entirety.

We selected students on the basis of (1) teachers' recommendations, (2) students statements in writing as to why they wanted to participate, (3) high school records and, (4) examination scores, in descending order of importance. Important is selecting students were personal interviews with several and conversations with teachers of most applicants.

Based upon achievement tests, PSAT scores, high school work, IQ scores, etc., we probably accepted nine (9) students who appear to be unlikely candidates to earn degrees in science or engineering. Four (4) of these, are members of a minority group. All have had limited opportunity and/or encouragement to study science. Of these nine, one (1) did superior work, and two (2) did very good work on their research problems. Four (4) of the nine were disappointing in their research. How could we refuse a student who says she wants "to be the best doctor in" her home state? We find in our experience with our two SST programs, and with Georgia Tech undergraduates, that desire to succeed is the necessary and almost sufficient condition for successful participation in SST programs and in subsequent study. At least seven (7) of these less than qualified students can "make it" in college in the difficult disciplines; we expect that at least half will "make it". We believe that their opportunity to compete with and learn from good students and experience college life helped these students immeasurably.

We called all students (except the applicant from Samoa) to clear up any questions about their applications and to extend invitations to participate in our program. This telephone contact was most helpful in gaining impressions of and reactions from students in cases where we could not interview them.

C. Soliciting Funds

Textile, carpet, fiber, and chemical manufacturers in southeastern United States were asked to contribute funds to help with costs of the program. Exactly $7600 was donated by ten corporations for use in this program. Rather late in the year, at the suggestions of one of the fiber producers, we suggested to manufacturers that they support one student from each locality in which they have operations. This suggested method of donation was well received. We shall use it in our attempt to make our NSF-SST program self sustaining.

II. The Participants

A. A Profile:

Based upon our experience with Georgia Tech students (average SAT scores ~1200) and rating as good those whom we would welcome as undergraduates in engineering and science, our estimates of the applicants at time of application is as follows:

	Gifted	Very Good	Good	Fair	Poor	Limited Opportunity in Science
Participants (38)	8	13	8	7	2	22
Other applicants (6)	0	2	1	3	0	5
	8	15	9	10	2	27

At least twenty-two (22) of the participants have had limited opportunity in science. A further description is given by the following data:

Number of girls	15
Number of boys	23
Number of members "of minority groups"	8
Number from inner city	2
Number from suburbs and smaller cities	16
Number from small towns and rural areas	20
Number with very good or superior over-all opportunity	13
Number whose opportunities could be improved	25
Number who lived on campus during program	33

B. Names, Addresses, High Schools

Joel Daphana Abel
508 East Seventh Street
Ocilla, Georgia 31774

Irwin County High School
P.O. Box 106
Ocilla, Georgia 31774

Virginia Edith Ballard
4235 Sunken Court
Port Arthur, Texas 77640

Thomas Jefferson High School
2200 Jefferson Drive
Port Arthur, Texas 77640

Michael Patrick Batey
2910 Gallalee Road, Southeast
Huntsville, Alabama 35801

Huntsville High School
2304 Billy Watkins Avenue
Huntsville, Alabama 35801

Runette Lovetta Bell
901 East Seventh Street
Donalsonville, Georgia 31745

Seminole County High School
Marianna Road
Donalsonville, Georgia 31745

Richard Daniel Bishop
1110 North Main Street
Sylvester, Georgia 31791

Worth County High School
504 East Prince Street
Sylvester, Georgia 31791

Wendel Fred Brown
Route 1
Reidsville, Georgia 30453

Pinewood Christian Academy
Henry Street
Bellville, Georgia 30414

William C. Buck, Jr.
1929 Flournoy Drive
Columbus, Georgia 31906

Columbus High School
1700 Cherokee Avenue
Columbus, Georgia 31906

Kenneston Carr
1236 Hill Street
Conyers, Georgia 30207

Rockdale County High School
Bulldog Circle
Conyers, Georgia 30207

Cynthia Jewel Chrispen
804 Crawford Street
Donalsonville, Georgia 31745

Seminole County High School
Marianna Road
Donalsonville, Georgia 31745

Roy Wha Chu
2929 Country Squire Lane
Decatur, Georgia 30033

Shamrock High School
3100 Mount Olive Drive
Decatur, Georgia 30033

Byron Grady Dasher
Route 3, Box 100
Glennville, Georgia 30427

Pinewood Christian Academy
Henry Street
Bellville, Georgia 30414

Hiram Waite Dykes, Jr.
2817 Briarwood Drive
Huntsville, Alabama 35801

Huntsville High School
2304 Billie Watkins Avenue
Huntsville, Alabama 35801

David Gordon Edwards
Apt. E-5
3662 North Decatur Road
Decatur, Georgia 30033

Avondale High School
1192 Clarendon Road
Avondale Estates, Georgia 30002

Roy Quinn Freeman
510 South Irwin Avenue
Ocilla, Georgia 31774

Irwin County High School
P.O. Box 106
Ocilla, Georgia 31774

Dennis Charles Gilbert
201 Lakeview Drive
Sylvester, Georgia 31791

Worth County High School
504 East Prince Street
Sylvester, Georgia 31791

Boyd Brantley Griffin
P.O. Box 92
Hoboken, Georgia 31542

Brantley County High School

Nahunta, Georgia 31553

Karen Olivia Grisham
4715 Cambray Drive
San Antonio, Texas 78229

Oliver Wendell Holmes High School
6500 Ingram Road
San Antonio, Texas 78238

Beverly Grace Hancock
109 Woodland Circle
Calhoun, Georgia 30701

Calhoun High School
River Street
Calhoun, Georgia 30701

Alan M. Harben
Star Route
Dawsonville, Georgia 30534

Dawson County High School
P.O. Box 129
Dawsonville, Georgia 30534

Rosemary Higgins
6230 Auburn Drive
Riverdale, Georgia 30274

Woodward Academy
Rugby Avenue
College Park, Georgia 30337

Marvin David Jones
Route 2
Rochelle, Georgia 31079

Hawkinsville High School
South Warren Street
Hawkinsville, Georgia 31036

Howard Ernest Kennedy
2115 Clairmont Drive
Augusta, Georgia 30904

Academy of Richmond County
961 Baker Avenue
Augusta, Georgia 30904

Sara Jane Kinney
P.O. Box 196
Hardwick, Georgia

Baldwin High School

Milledgeville, Georgia 31061

Ivey Brent Laminack 121 Waddell Street Bremen, Georgia 30110	Bremen High School Bremen, Georgia 30110
Henry Thomas Land Route 2 Fitzgerald, Georgia 31750	Irwin County High School P.O. Box 106 Ocilla, Georgia 31774
Richard Charles Lewis 1717 Greenway Drive Augusta, Georgia 30904	Academy of Richmond County 961 Baker Avenue Augusta, Georgia 30904
Jarrell Ellenette Mack 2701 Georgia Avenue Tifton, Georgia 31794	Tift County High School West Eight Street Tifton, Georgia 31794
Juan Carlos Magarinos Box 837 Bayamon, Puerto Rico	Pine Crest School 1501 Northeast Sixty-second Street Fort Lauderdale, Florida 33308
Laura Mundy Mann 1201 Sherwood Drive Dalton, Georgia 30720	Dalton High School West Crawford Street Dalton, Georgia 30720
Bette Jean Marrinson 942 Plymouth Road, Northeast Atlanta, Georgia 30306	Henry Grady High School 929 Charles Allen Drive, N.E. Atlanta, Georgia 30309
Michael Worth Martin Route 4 Rome Road Calhoun, Georgia 30701	Calhoun High School River Street Calhoun, Georgia 30701
Olivia Diane Martin 2206 Smiley Avenue Prichard, Alabama 36610	Blount High School 838 West Main Street Prichard, Alabama 36610
Edward Wayne Minor 706 East Barnard Street Glennville, Georgia 30427	Pinewood Christian Academy Henry Street Bellville, Georgia 30414
Preston Edward Oliver, Jr. 402 Wacona Drive Waycross, Georgia 31501	Ware County Senior High School Route 4, Box 93 Cherokee Avenue
Margaret Helen Raymond 7220 Hullwood Kansas City, Missouri 64133	Notre Dame de Sion High School 10631 Wornall Road Kansas City, Missouri 64133
Roger Lee Sams 805 Second Street Ocilla, Georgia 31774	Irwin County High School West Sixth Street Ocilla, Georgia 31774

Sharon Denise Weems 612 Commercial Avenue Atlanta, Georgia 30318	West Fulton High School 1890 Bankhead Highway Atlanta, Georgia 30318
Susan Jane Williams 3931 Bonnington Court Chamblee, Georgia 30341	Chamblee High School 3688 Chamblee-Dunwoody Road Chamblee, Georgia 30341
Michael Reginald Virro Bldg. 17, Apt. 481 Sandy Springs, Georgia 30328 (Mike Virro dropped out after the first week.)	Cotopaxi High School Cotopaxi , Colorado 81223

III. The Program

A. Research

The purpose of the program was to introduce students to research and help them to carry out research programs of some merit. Most time and most energy was devoted to that end. Thirty-eight (38) student participants worked on thirty-three (33) different research projects with twenty (20) research advisors. Decent, meaningful data were obtained in at least twenty (20) of the projects. Results from several of these projects will be published as on-going research is finished. Names of students, titles of problems, and names of advisors are as follows:

Student	Research problem	Adviser
Daphne Abel	Physical properties of adhesives and bonds in carpets.	D.R. Gentry
Gini Ballard	Making photosensitive glasses.	J.F. Pentecost
Pat Batey	Mechanical properties of fibers at high strain rates.	W.D. Freeston, Jr., & F.K. Ko
Runette Bell	Yarn structures: effects of yarn twist on yarn strength.	R.C. Lathem
Dan Bishop	Measurements of the strain electric effect in bone.	J.L. Lundberg & H. Chen
Fred Brown	Measurements of angular dependence of light scattered by fibers.	J.L. Lundberg

Student	Research problem	Adviser
Bill Buck	The effects of plasmas on chemical and physical properties of polymers.	W.C. Tincher
Kent Carr	Mechanical properties of fibers at high strain rates.	W.D. Freeston, & F.K. Ko
Cynthia Chrispen	Light scattering studies of cataracts.	R.F. Borkman
Roy Chu	Investigation of flurocarbons as blood extenders and media for respiration.	W.L. Bloom & J.L. Lundberg
Byron Dasher	Measurement of angular dependence of light scattered by fibers.	J.L. Lundberg
Waite Dykes	Effects of nuclear radiation on the properties of polymers.	W.C. Carter
David Edwards	Study of intermediates in the reactions of phenol and formaldehyde.	W.C. Carter
Quinn Freeman	Effects of nuclear radiation on the properties of polymers.	W.C. Carter
Dennis Gilbert	Effects of material and structural parameters on the flammability of textiles.	W.D. Freeston, & W.C. Tincher
Boyd Griffin	Measurement of molecular weights by light scattering.	J.L. Lundberg
Karen Grisham	Designing and weaving fancy fabrics using Jacquard looms.	A.H. Tayebi & B. Strauss
Beverly Hancock	Spectrophotometric analysis of water for dye carriers.	W.C. Tincher
Alan Harben	Measurement of the effects of additivies on the flammability of carpets.	W.C. Boteler & W.C. Tincher
Rosemary Higgins	Design and weaving fancy fabrics using Jacquard looms.	A.H. Tayebi & B. Strauss
Marvin Jones	Mechanical properties of canine aortoe.	F.K. Ko, H. Che D.P. Giddens

Student	Research problems	Advisers
Howard Kennedy	Development of new latex adhesives for carpets.	W.C. Boteler
Sara Jane Kinney	Mechanical properties of canine aortae.	F.K. Ko, H. Chen & D.P. Giddens
Brent Laminack	Plasticizers for nylon to vinyl adhesives. Astrophysics:"black holes" (self study).	W.C. Boteler
Tommy Land	Mechanical properties of dried latex adhesives and latex bonded carpets.	D.R. Gentry
Richard Lewis	Preparation and properties of transcrystalline polymers.	J.D. Muzzy
Jarrell Mack	Physical properties of adhesives and bonds in carpets.	D.R. Gentry
Juan Magarinos	Superconductivity and organic superconductors. Artificial intelligence (self study).	R.E. Little
Mundy Mann	Making photosensitive glasses.	J.F. Pentecost
Bette Marrinson	Designing and weaving fancy fabrics using Jacquard looms.	A.H. Tayebi & B. Strauss
Mike Martin	Brick making: new glazes for Georgia clays.	J.K. Cochran
Olivia Martin	Mechanical properties of canine aortae.	F.K. Ko, H. Chen & D.P.Giddens
Ed Minor	Analysis of impurties in water by fluorescence spectrophotometry.	W.C. Tincher
Rusty Oliver	Crosslinking polyvinyl alcohols Problems in computer programming.	W.C. Carter Cheryl Allen
Margaret Raymond	Making paper from corn cobs; properties of papers.	G.R. Lightsey
Lee Sams	Design and development of a new bed for burn patients.	W.D. Freeston, J.
Sharon Weems	Physical properties of adhesives and bonds in carpets.	D.R. Gentry

Student	Research problems	Advisers
Susan Williams	Anionic polymerization of caprolactam to form nylon 6	W.C. Tincher

Research advisers for these students were as follows:

Name	Degree	Position	Specialty
Cheryl Allen	B.S. (Math)	Systems Analyst	Computer programming
W.L. Bloom	M.D.	Professor, Assoc. Vice-pres. for Academic Affairs.	Physiology
R.F. Borkman	Ph.D. (Chem)	Assoc. Prof., Chemistry.	Physical chemistry
W.C. Boteler	M.S. (Mech Engrg)	Prof. Textile Engrg.	Textile and mechanical engrg
W.C. Carter	Ph.D. (Chem)	Prof. Textile Engrg.	Polymer & textile chemistr
H.Y. Chen	Ph.D. (Bio. Engrg.)	Asst. Prof. Engrg Sci. & Mech.	Bioengineering
J.K. Cochran	Ph.D. (Cer. Engrg.)	Asst. Prof. Ceramic Engrg.	Glazes & enamels
W.D. Freeston	Ph.D. (Mech. Engrg)	Prof. & Director, Textile Engineering.	Mechanics of fibrous structures
D.R. Gentry	Ph.D. (Mgmnt)	Assoc. Prof., Textile Engineering.	Textile structures, management in fiber & text industries
D.P. Giddens	Ph.D. (Aero. Engrg.)	Assoc. Prof., Aero-space Engrg.	Turbulence, biorheology
F.K. Ko	M.S. (Textile Engrg.)	Grad. Res. Asst. Textile Engrg.	Viscoelasticity, Textile engineering
R.C. Lathem	M.S. (Econ.)	Assoc. Prof. Textile Engrg.	Yarn formation
G.R. Lightsey	Ph.D. (Chem. Engrg.)	Asst. Prof. Chem. Engrg.	Paper and plastics
R.E. Little	Ph.D. (Phys.)	Asst. Prof. Physics	Cryogenics & superconducti
J.L. Lundberg	Ph.D. (Chem)	Callaway Prof. Textile Engrg.	Polymer chem. & phys.
J.D. Muzzy	Ph.D. (Mtls. Sci)	Assoc. Prof. Chem. Engrg.	Polymer Sci. & engrg.
J.F. Pentecost	Ph.D (Cer. Engrg)	Prof. & Director, Ceramic Engrg.	Pyrometry and analysis, glasses
Barry Strauss	B.S. (Text Engrg)	Graduate Research Asst.	Textile structures, weaving
W.C. Tincher	Ph.D (Chem)	Assoc. Prof., Textile Engineering.	Polymer and textile chem.
A.H. Tayebi	Sci.D. (Mech Engrg)	Asst. Prof, Textile Engineering.	Fiber & textile mechanics and structures

Two of the students are continuing their research problems. Roy Chu is working at Georgia Tech; Margaret Raymond is continuing her work at home and in school in Kansas City.

B. Seminar and Demonstration Program

The seminars and demonstrations were similar to those outlined in the proposal. The forty-five (45) seminars in science, engineering, and mathematics centered around polymers, fibers and textiles are described briefly in Appendix II. These seminars and demonstrations together with students research reports on the last three days of the program took up about seventy-five (75) hours. Attendance was required at these seminars.

Seminar speakers and demonstrators were nine of the ten members of the faculty of the School of Textile Engineering. These are:

Name	Degree	Position	Specialty
W.C. Boteler	M.S. (Mech Engrg.)	Professor	Mech. & textile engrg.
W.C. Carter	Ph.D (Chem.)	Professor	Polymer & textile chem.
W.D. Freeston	Ph.D. (Mech.Engrg.)	Professor & Director	Mechanics of fibrous structures
D.R. Gentry	Ph.D. (Mgnt.)	Assoc. Prof.	Fiber and textile struct and properties
R.C. Lathem	M.S. (Econ.)	Assoc. Prof.	Yarn formation
J.L. Lundberg	Ph.D (Chem.)	Callaway Prof.	Polymer chem. & phys.
L.H. Olson	Ph.D (Textile Phys.)	Asst. Prof.	Textile & fiber phys.
A.H. Tayebi	Sc.D (Mech. Engrg.)	Asst. Prof.	Textile mechanics
W.C. Tincher	Ph.D. (Chem.)	Assoc. Prof.	Polymer & textile chem.

C. Colloquia

Students enjoyed eight colloquia with speakers from outside the School of Textile Engineering. Five speakers came from off campus; three were from other schools at Georgia Tech. About thirteen (13) hours were devoted to

colloquia. Attendance was required.

Speakers, affiliations, subjects, and times are given in Appendix III.

D. Computing Seminars, Demonstrations, Clinics, etc.

All students visited the Georgia Tech Computer Center and were briefed on using Univac 1108 and PDP8 computers and plotter. All students were authorized to use the computer and given necessary identification, account numbers, etc.

All students were introduced to small computers and a plotter in the School of Textile Engineering.

Mrs. Cheryl Allen of the Computing Services Department conducted four two-hour sessions on programming and use of the plotter in the Computer Center. Thanks to her efforts, several of the students became quite proficient in using the Univac 1108 computer and the plotter.

Details are given in Appendix IV.

E. Special Seminars on Advanced Subjects

Twelve special seminars on thermodynamics, quantum mechanics, statistical thermodynamics, and light scattering were offered with attendance voluntary. Eight students participated in the whole program. Six others attended most of the seminars.

Subjects and times are given in Appendix V.

F. Field Trips and Visits

All students visited the Fernbank Science Center (operated as part of the Dekalb County school system), the nylon filament manufacturing plant of the American Enka Corporation in Central, S.C., and the nuclear and hydroelectric facilities of the Duke Power Company at their Oconee Station near Seneca, S.C.

On the Georgia Tech campus, all students visited the library, computer center, the Engineering Experiment Station, and the Schools of Ceramic Engineering, Chemistry, Electrical Engineering, and Physics as part of the orientation to and becoming acquainted with Georgia Tech.

Details of visits and experiments and facilities demonstrated are given in Appendix VI.

G. Science Movies

Movies on science and engineering were shown four (4) evenings each week, usually from 6:30 to 7:30 or 7:45 p.m., in the first, second, third, and sixth weeks of the program. Attendance was optional. Usually from ten to twenty students attended showings.

A partial list of films shown is given in Appendix VII.

H. Recreational and Group Activities

Ten (10) recreational and group activities were enjoyed by the group in the 48 days from Sunday, June 16th, and the last day of the program, August second. Average intervals between group activities was five days; the longest was eight days. High school juniors and seniors need and want both structured group recreation and unstructured, unplanned activities. Campus recreation facilities and teen-age creativity combine to provide sufficient of the latter. Mr. A.J. Maguire, III, and the faculty of the School of Textile Engineering tried to provide sufficient and varied recreational and group activity. No funds provided by the Foundation can be or were used in any way to support recreational and group activities. Details of these activities are given in Appendix VIII.

I. Communication

In order to provide communication, the following channels were used: (1) Weekly programs (schedules) were provided to each student. (2) Orientation

and question and answer sessions were held by faculty members, Mr. A.J. Maguire, and student dormitory counselors, Miss Rebecca Byrd and Mr. Eric Esche. (3) Good rapport and communication among NSF-SSTP students, Georgia Tech undergraduate and graduate students in the School of Textile Engineering, faculty, Mr. Maguire, and SSTP counselors developed quite naturally, particularly in the lobby of the School of Textile Engineering Building which serves as a meeting place. (4) Visits by faculty members and Mr. Maguire to the domitories. (5) Faculty members and SSTP students eating together, particularly at lunch.

IV. Results of the Program: Evaluation

A. Assessment of Research Results

The program director graded the research activity of each of the participants for purposes of this report only. These estimates of performance have been communicated to no one else. Grades were based on: (1) students' research reports, (2) estimates of research advisors communicated to the program director; (3) observations of and conversations with students by the director in the laboratories; (4) general impressions by the members of the faculty, research advisors other than the students' advisors, and the director. Estimates of research performance compared to estimates of abilities of applicants as given in Section II. 1 (page 5) are given in Table I. (The grade, "Good", with grade point 2.0, is characteristic of abilities and work of students whom we would welcome to Georgia Tech as students of engineering, science, or mathematics.)

Table I

Comparison of Estimates of Students' Research Performance with Estimates of Their Abilities as Applicants for the NSF-SST Program

			Research Performance					
			Superior (4)	Excellent (3)	Good (2)	Fair (1)	Poor (0)	Average GPR
	Number of Students		11	8	9	7	3	2.4_5
Gifted	(4)	8	2	1	2	3	0	2.3
Very Good	(3)	13	4	4	2	2	1	2.6
Good	(2)	8	4	2	1	1	0	3.0
Fair	(1)	7	1	1	3	1	1	2.0
Poor	(0)	2	0	0	1	0	1	1.0
Avg. GPR		2.4_7						

The estimates of performance versus ability support the thesis that ability is of secondary importance as compared to desire as a necessary prerequisite for success. The students estimated to be "Good" and "Fair" in abilities performed beyond expectations. The students of "Very Good" ability did well in their research. Too often "Gifted" students seem to be lazy; high school is too easy for them. To expect them to learn new work habits in a couple of weeks so that they can perform well during the program is unreasonable. At least four of the five "Gifted" students, who disappointed themselves as well as the faculty by research performance below their abilities, learned from their experience that they have to work as hard as they can; for them the program was invaluable.

The twenty eight (28) students who scored from "Good" to "Superior" on estimates of research performance and perhaps six (6) of the others

profited from their experience. The remaining four must mature before they will succeed in studies; three of the four should "make it". Participation in the program helped the maturing process.

B. Students' Evaluation of The Program

Students' evaluations of the Georgia Tech 1974 SST program were favorable, probably too much so. In the fourth week of August, Mr. A. J. Maguire, Counselor for Incoming Students in the School of Textile Engineering, sent to participants a questionnaire (Appendix IX). Twenty-eight (28) of a possible thirty-eight (38) responses were received by October 15, 1974. Numerical results are given in Appendix IX. From the student evaluations we conclude:

1) Students are programmed for one hour classes; our seminars are long for them.
2) Seminars should be limited to 90 minutes per day on most days.
3) Seminars were conducted at about the right level (freshman to sophomore level in college).
4) We should have had more than five (5) seminar speakers from off campus and three (3) from other schools at Georgia Tech.
5) We can increase the amount of material covered in seminars.
6) We probably had enough different research topics, but we'll increase the number and variety to satisfy the few who want more.
7) Sufficient time was spent on research.
8) Students were satisfied with faculty assistance in research.
9) Material and instrument procurement was easy for about 60 percent of the students and difficult for 40 percent; this must be improved.

10) More time should be devoted to orientation to research facilities on campus; attendance of additional sessions probably should be voluntary.

11) Students appreciated and enjoyed organized outings for recreation.

12) Twenty six (26) of the twenty-eight (28) respondents will recommend the Georgia Tech SSTP to fellow students without change or with a few minor changes in the program. Two (2) participants recommend major changes.

C. Good points in the program

The most effective feature of the program was research. Most of the participants got real results; most remained or became "turned on" by science or engineering. Thirty eight (38) of thirty-nine (39) participants, were active in the program for the whole seven weeks.

The colloquia were popular with students and particularly effective. Five visitors came from Texas, Ohio, Washington, D.C., and from Augusta and Norcross in Georgia to present seminars; these visitors received no expense monies nor honoraria from Georgia Tech.

The four extra seminars on computer programming and plotting, presented by Mrs. Cheryl Allen of the staff of the Georgia Tech Computer Program, were most helpful to students; they enjoyed and appreciated these seminars. Several of the students became quite adept in computing and plotting using the Univac 1108 computer and the Calcomp plotter.

Several students attended the twelve (12) extra seminars on thermodynamics , quantum mechanics, statistical thermodynamics, and light scattering. Juniors and seniors in high school can comprehend the central ideas, methods, and results of these subjects every bit as well as graduate students. Students' response to being introduced to wave

equations in classical mechanics and to Schrodinger's wave equation was gratifying. The same is true of thermodynamics, statistical thermodynamics, and scattering. In all cases, the central physical ideas were emphasized. The opportunities to introduce students to trigonometry, calculus, differential equations, and mechanics, electricity, electromagnetics, and optics were used to the fullest.

Teaching science and engineering without regard to disciplines and teaching mathematics as part of science was effective. Comments from students in both the 1973 and 1974 programs about the help to them that an understanding of the fundamentals of subjects, such as calculus, for example, has been since they have returned to school are gratifying and indicate that teaching science and mathematics together give relevance to an otherwise abstract subject.

The visits to the nylon plant of the American Enka Corporation and the nuclear power plant of the Duke Power Company were most instructive. Few students have any appreciation for, let alone first hand knowledge of, manufacturing, industry, and the work-a-day world. These visits were real "eye opening" experiences for many of the students. None of the students had knowledge of the magnitude and sophistication of these and other industrial operations.

Living on campus with all of the distractions and temptations of Atlanta helped several of the students to adjust to being at college away from home without the penalty of failure. A few of the students probably would have failed in the first quarter or semester in college without this experience.

D. Problems in the program

The greatest single problem in both 1973 and 1974 was helping the

students to some feeling for the nature of science and engineering. Most of the students' experience is limited to learning in schools with a highly structured, organized, and quite dogmatic approach and system. Few students have any feel for the experimental method and deductive reasoning. Further, few of the students seemed to have been encouraged to doubt, question, and test what they read and what they are told. Most of the participants are not skilled in working in unstructured laboratory programs; therefore, the research experience while helpful to the students required judgement and patience from research advisors to prevent students from becoming bogged down or being led by the hand.

In answering students' questions concerning colleges, curricula, research, etc. the dependence of even the brightest and mose independent upon the structured requirements, curricula, and mode of operation of secondary schools is apparent. Most high school students seem to have difficulty comprehending the range of choices offered in college or university.

In our 1974 program, some separation along racial lines was apparent among the girls. Among the girls, several had almost no contact with people of other races. Part of the difficulty was not racial but merely learning to live in a dormitory. These girls learned to get along with one another and together and not to expect special or favored treatment because of color of skin, be it light or dark.

E. Changes in future programs

Changes which we shall make in programs in future years will be to provide even more research problems in more fields in the School of Textile Engineering and in other schools at Georgia Tech. This will give students greater choice in selecting research problems. Also, each year we shall be able to accommodate a wider variety of student originated research

problems. The number, range of interests, research activity, and interdisciplinary collaborative efforts of faculty members in the School of Textile Engineering and other schools at Georgia Tech are increasing.

We shall have more research problems closer to "go" condition in future years. In some cases participants have spent too much time in obtaining equipment and materials. Further, we are becoming more skilled in helping students to define problems more quickly than they would without help and to do this without "leading the students by the hand".

F. Effects of program

The effect on participants was to increase in each an appreciation of science and engineering and an eagerness for real study at the university level. The SST program is excellent for recruiting good students to good schools. Seeing science and engineering first hand at Georgia Tech convinced one undecided student that he must go to college. It has caused a few students with vague notions about studying some more esoteric subjects to consider science and engineering including polymer, fiber, and textile science and engineering.

Another effect of the program on some of the participants was to help them to "aim higher", at better colleges and universities in more difficult curricula. This broadening of interests and horizons and the realization that they can "make it" in the better schools means that several the thirty-eight (38) participants probably will register in science or engineering curricula in strong schools instead of beginning in less demanding curricula in lesser schools.

At least two of the students are continuing to work on their research problems. One student is continuing his work at Georgia Tech.

Students in our 1974 program did not develop the real friendship for one another that was obvious in the 1973 group. However, the 1974 group enjoyed being together, enough that they will come to Georgia Tech on January 10th, 11th, and 12th for a reunion. This regard for one another and communication among most students bridged differences in economic status, background, preparation, sex, and race. The participants learned at least as much from each other as they did from faculty and staff.

The principal effect of both the 1973 and 1974 programs on the School of Textile Engineering is that we started or pushed forward some research programs which would have languished without this spur. Of the problems worked on by students in 1974, at least sixteen (16) are being continued; of these at least half received major impetus from students working on the problems.

Another effect upon our school was to further acquaint us with and make us much more senitive to hopes, needs, thinking, problems, strengths, and weaknesses of young people who are likely candidates for science and engineering. We learned how to reach several of these people through their schools, families, friends, etc. The School of Textile Engineering will continue to increase its contacts with potential students of science by visiting more schools, giving more seminars and demonstrations in schools, helping more teachers and students with research projects and demonstrations, entertaining more visiting students and teachers at Georgia Tech, etc.

G. Follow-up on the program

Follow-up on the program has begun. All participants have received at least one letter from faculty and staff of the School of Textile Engineering. All have received a questionnair requesting participants'

reactions to the program; twenty-six (26) participants have responded. One participant is studying civil engineering at Georgia Tech in the early enrollment plan.

Faculty members of the School of Textile Engineering have helped two of the participants to continue working on their research programs.

A demonstration kit showing polymerization of nylon, rubber elasticity, drawing and texturing of fibers, fabric flammability, dyeing and finishing of fabrics will be distributed in November, 1974 to each of the high schools from which participants came. The student participants in SSTP will use these to demonstrate to fellow students some of what they have learned about polymers, fibers, and textiles.

The student participants, teachers who can come, and Georgia Tech staff and faculty will come to campus as guests of the faculty on January 10th, 11th, and 12th for a reunion, recreation, and fellowship. At that time and in subsequent letters we shall learn the career plans of participants. We shall keep in touch with participants until they have enrolled in colleges or become permanently employed after leaving school.

V. Suggested Improvements in the National Student Science Training Program

This program is excellent; it reaches young people at the right time to save a few for science in spite of the thrust of secondary education away from science and other difficult disciplines. Further, our SST program makes some students aware of opportunities for study in less well known programs such as textile chemistry and textile engineering. Students have to know of the existence of programs before they come to college if they are to consider enrolling in them.

The Foundation's staff knows better than we the two biggest improvements which can be made in the program. These are:

1) a) adequate funding for 200 to 500 individual programs, and

2) b) announcing grants before September first of each year to give adequate time for publicizing programs and seeking additional funds for the following summer.

Including high school teachers in the program as is planned for 1975 is excellent. We have discussed this with quite a few high school teachers; their response has been encouraging.

Appendix II

Seminars and Demonstrations for NST-SST
Program June 17 - August 1, 1974

No.	Subject
1	Our World of Giant Molecules - An introduction to polymers and fibers and our environment composed of macromolecular materials man's and nature's polyamides, polyesters, polyethers, and vinyl polymers. J. L. Lundberg
2	Stress - Strain Behavior - Force, Newton's second law of motion, Hooke's law, non-linear stress strain behavior, creep and flow. W.D. Freeston, Jr.
3	Concepts of Equilibrium - Static equilibria, forces at equilibrum, dynamic systems, acceleration, Newton's laws of motion, dynamic equilibrium. J.L. Lundberg
4	Near Equilibrium Kinetics - The postulate of near equilibrium (linear) kinetics, the pendulum, Newton's law of cooling, Newton on "the slipperiness of liquids", viscous flow, turbulent flow, Ohm's law, chemical kinetics, and diffusion. J.L. Lundberg
5	Viscoelasticity of Polymers - "Silly putty" used to demonstrate elasticity, flow, and brittle failure; linear viscoelasticity, springs and "dash pots" (door closers & shock absorbers); tensile creep, stress relaxation; nonlinear behavior of strong nylons and polyolefin fibers. J.L. Lundberg

No.	Subject
6	Molecular, Size and Shape - Oxygen methane, ethane, structural isomerism of 2,2,4 trimethylpentane and n-octane, and $C_{40}H_{82}$ demonstrated with molecular models; a "pull chain" model of a polymer of degree of polymerization 7200; polymers we can see (DNA by electronmicrography); stereoisomerism of polyglucosides and polyisoprene, two dimensional polymers (crosslinking), and three dimensional polymers (diamond, graphite, SiO_2, water, etc.) J.L. Lundberg.
7	Periodicity and Chemical Bonding - Combining ratios, the law of simple combining proportions("the exception which proves the rule"), the rule of octets, oxidation state, the periodic table, covalent bonds, ionic bonds, etc. W.C. Carter.
8	Vinyl Polymerization and Copolymerization - C-C and C-H bonds, C=C bond, ethylene polymerization, other vinyl polymerizations. W.C. Carter
9	Vinyl Polymerization and Copolmerization - Vinyl polymerization (cont'd), free radical vs. ionic polymerization of ethylene and propylene, stereoregularity, properties of polymers, polyvinyl alcohol, polyacrylonitrile, polyvinylchloride, polymethylmethacrylate, etc. Copolymers of butadiene and styrene, acrylonitrile-butadiene styrene resins, saran, modacrylics, "polymerizing in" dye sites, etc. W.C. Tincher
10	Chemical Bonding: Carbon - oxygen Bonds, etc - Ethers, alcohols, acids, esters, esterification, transesterification, ethyl acetate, hydrolysis of esters, polyethylene terephalate, other esters.W.C. Tincher

11. Oxygen Bonded Polymers - Polyesters (cont'd), polyethers, sugars, cellulose, starch, etc. Other esters: DNA, polycarbonates etc. W.C. Tincher

19. Molecular Weight of Polymers - Molecular weights of small compounds, average MW of air, average molecular weights, J.L. Lundberg

20. Molecular Weight Distributions, Summations & Integration. MW distributions, averages, summations, integration, moments of areas. J.L. Lundberg.

21. Polymers and States of Matter - Glassy, rubbery, and crystalline polymers; specific volume, dilatometry, heat capacity; moduli of elasticity, viscosities; time scales; toughness and strength. J.L. Lundberg

22. Glassy Polymers - Glass transitions, structures of and order in glasses and crystals; SiO_2& B_2O_3 glasses; polystyrene, polymethylmethacrylate etc. A.H. Tayebi

23. Rubber Elasticity - Heating and cooling on stretching and release (rubber band and upper lip experiment), temperature coefficients of rubbery and energy elastic materials, ideal rubber and ideal gas equations, disorder. A.H. Tayebi

24. Crystallization of Polymers - Chain folding, fold length, electron microscopy and diffraction on single crystals, extended chain crystals, intercrystalline links, less ordered material. J.L. Lundberg

25. Morphology of Polymers - Spherulites, row crystallization, effect of shear on nucleation and morphology, composite structure model for polymers. J.L. Lundberg

12. Carbon- nitrogen Bonding and Polymers - The - C - N - and -C ≡ N bonds, polyacylonitrile, NH_3, fertilizer amines, diamines, amides, hydrolysis of amides, polyamides, etc. W.C. Tincher

13. Nylons, Proteins, etc - Nylon 66, w-amino acids, nylon 6, nylon 610, the "nylon rope trick"; α - amino acids, proteins, collagen, elastin, keratin, fibroin, albumin, - globulin, casein, hemoglobin, enzymes, viruses, etc. W.C. Tincher.

14. Other Bonds: -P- O- ,-S-C-, etc. Sulfides, polysulfides, phosphoric acid, phosphates, fertilizer, polyphosphates, phosphate esters, DNA, etc. W.C. Carter

15. Ionic Bonds Polyelectrolytes etc.- Strong electrolytes, alkali halides, hydroxides, ionization, polyacrylic acid, polyvinylpyrollidone, ion exchange resins. W.C. Carter

16. Chemical Kinetics and Differential Calculus -Rate, time, distance; acceleration; first and second deviratives; radio-active decay. J.L. Lundberg

17. Rates of Chemical Reactions - First and second order reaction rates, examples, molecularity, mechanisms, temperature de-pendence. W.C. Tincher.

18. Chain Reactions & Kinetics of Polymerization - Chain reactions, chain branching, typical time vs conversion curves, slow oxidation, combustion, explosion; initiation, propagation, termination of polymerization; rate of polymerization. W.C. Tincher

26. Flow of Polymers - Newton on flow, viscosity defined, non-Newtonian flow, psuedoplastic flow, elastic flow, molecular weight and temperature dependence of apparent viscosity. J.L. Lundberg

27. Melt Spinning of Fibers - Melting, filtration, and extrusion of polymer, attenuation of melted fibers, freezing, and wind-up of fibers described in detail in preparation for visit to American Enka Corporation. W.C. Carter.

28. Wet Spinning of Fibers - Viscose process for making rayon described; wet spinning of viscose, polyacrylonitrile, polyvinyl alcohol discussed, and wet spinning of PVA demonstrated. W.C. Carter

29. Drawing and Texturing of Fibers - Discussion of drawing of fibers and changes in structure and morphology in polyethylene, nylon, and polyester (to the extent this is known); hand drawing of polyethylene, polypropylene, and nylon by students; lecturing methods; demonstration of texturing. J.L. Lundberg

30. Properties of Fibers - Demonstration and comparison of high strengths of fibers in tension and discussion of transverse properties of fibers. W.D. Freeston, Jr.

31. New Fibers - High strength, high modulus fibers: new nylons, graphite, boron nitride, tungsten, corundum, metal fibers, glass fibers; uses of high strength fibers. W.D. Freeston, Jr.

32. Dyes - Color in dyes, substantivity, natural dyes, synthesis of dyes, history of dyeing. W.C. Carter

33. Color - What is color? How do we perceive color? Color measurement, color matching, dye formulation, etc. W.C. Tincher

35. Flammability - Combustion, ignition, propagation of flames and chars; demonstrations of flame retardants on fibers, fabrics, and carpets; flammability requirements; present and future. W.C. Tincher

34. Dyeing - Classes of dyes, application of dyes, demonstrations of dyeing and printing. W.C. Carter

36. Finishing of Fabrics - Durable press, soil release, water repellance, flame retardance, etc. described and demonstrated; some chemistry of modifying fibers. W.C. Tincher

37. Yarn Formation - Staple fiber, conversion of staple fibers to yarns, demonstration of yarn making. R.C. Lathem

43. Composites - Fiber reinforced composite structures including laminates; demonstrations of structures and properties (tensile strength, impact strength, stiffness, flexure, etc) of composite structures; how composite structures function; composite and design - the future. W.D. Freeston, Jr.

41. Carpets - History of carpets, hand methods, woven carpets, weaving, tufting, needle punching, dyeing and finishing carpets; demonstrations of weaving, needle punching, and tufting. W.C. Boteler

38. Fabric Formation - History of weaving and weaving design, warping, slashing, drawing-in, weaving described and demonstrated; hand looms, cam, dobby, Jacquard, water jet and rapier looms demonstrated. A. Tayebi

39. Fancy Weaves - Fancy fabric designs and Jacquard weaving; automation, punched card machine control, use of computers in design. A. Tayebi

42. Design of Fabric Structures - Special fabrics, triaxial fabrics, fabrics for composite structures, three dimensional fabrics - demonstrations. D.R. Gentry.

40. Knitting - Weft and warp knitting, knitting design, knitting machines; demonstration of knitting machines; fancy knitting and patterning and control of knitting machines. L.H. Olson.

44. Nonwoven Structures - Paper-like nonwovens, films, fibrillation, spun-bonded materials, flocking, etc; demonstrations; forming nonwovens into garments. W.D. Freeston, Jr.

45. Polymers, Fibers and Textiles in the Future - Needed new fibers, increasing demand for fibers and textiles; food, fibers, and shelter needs and supplies; new uses for fibers - textile fibers in construction. J.L. Lundberg

46,47,48 Research Conferences - Presentation of reports on research by student participants.

Appendix III

COLLOQUIA FOR NSF-SST PROGRAM JUNE 17-AUGUST 1, 1974

1. "Ceramics and Glasses" - James F. Benzel, Ph.D, Associate Professor, and Joe K. Cochran, Ph.D. Assistant Professor, School of Textile Engineering, Georgia Institute of Technology, Wednesday, June 19, 1974.

2. "Oil, Energy, Plastics and Telephone Service" - Thomas W. Huseby, Ph.D., Head, Materials Engineering and Chemistry Department, Bell Telephone Laboratories, Inc, Atlanta, Georgia, Wednesday, June 26, 1974.

3. "Fibrous Polymers in the Human Body" - Robert A. Liebelt, M.D., Ph.D., Provost, Medical College of Georgia, Augusta, Georgia, Wednesday, July 3, 1974.

4. "Nuclear Science and Engineering" - Geoffrey G. Eichholz, Ph.D., Professor, School of Nuclear Engineering, Georgia Institute of Technology, Wednesday, July 10, 1974.

5. "Glass Fibers" - Neal Greene, Ph.D., Head, Physical and Engineering Research, Owens Corning Fiberglas Corporation, Granville, Ohio, Friday, July 19, 1974.

6. "Engineering Sciences and Mechanics" - Milton E. Raville, Ph.D, Professor and Director, School of Engineering Science and Mechanics, Georgia Institute of Technology, Wednesday, July 24, 1974.

7. "Some Problems in Petroleum and Petrochemicals" - Wiley P. Ballard, B.S. (Ch.E.), Manager, Port Arthur Research Laboratories, Texaco, Inc., Port Arthur, Texas, Tuesday, July 30, 1974.

8. "The White House Fellows Program, Agriculture, Needs for Food, etc" - James E. Bostic, Ph.D., Deputy Assistant Secretary, U.S. Department of Agriculture, Washington, D.C., Friday, August 2, 1974.

Appendix IV

COMPUTING SEMINARS, DEMONSTRATIONS, CLINICS, ETC.

1. Visit to Georgia Tech Computer Center; 1-3 p.m., Thursday June 20, 1974; Cheryl Allen, Glenn M. Miller, and Jerry W. Segers, Office of Computing Services.

2. Introduction to Small computers and plotter in the Textile Engineering Building; in three groups, 10 a.m. - 12 N, Thursday, June 20, 1974, and 10 a.m. - 12 N , 1-3 p.m. Friday, June 21, 1974; John Smith, Graduate Research Assistant, School of Textile Engineering

*3. Introduction to programming, 10 a.m. - 12N, Monday, June 24, 1974; Cheryl Allen, Office of Computing Services, Georgia Tech Computer Center.

*4. Programming continued, 1-3 p.m., Tuesday, June 25, 1974; Cheryl Allen

*5. Programming clinic, 10 a.m. - 12 N, Wednesday, June 26, 1974; Cheryl Allen.

*6. Plotting with the computer, 1-3 p.m., Thursday, June 27, 1974; Cheryl Allen.

* Attendance optional

Appendix V

SPECIAL SEMINARS ON ADVANCED TOPICS (Attendance Optional)

1. Thermodynamics - 1st postulate, state functions, heats of reactions, heat capacities, etc; Thursday, June 20, 1974.

2. Thermodynamics - 1st postulate (cont'd), Bernoulli's equation, heat engines, 2nd postulate, Carnot cycle, Monday, June 24, 1974.

3. Thermodynamics - 2nd postulate, Carnot cycle, engines, cont'd; entropy change and temperature, calculating entropy changes; Thursday June 27, 1974.

4. Thermodynamics - phase changes, Clausius - Clapeyron equation, Gibbs free energy, temperature dependence,equilibria; Monday, July 1, 1974

5. Thermodynamics - chemical equilibria, free energies, 3rd postulate of thermodynamics, entropy balances, disorder; Thursday, July 7, 1974.

6. Thermodynamics - heterogeneous equilibria, solutions, Raoult's and Henry's laws,colligative properties, Monday, July 8, 1974.

7. Planck's Quantum Mechanics - Quantum theory and thermodynamics by Planck from his 1901 paper. Thursday, July 11, 1974

8. Quantum mechanics - Wave equation, particle in box, rigid rotor, harmonic oscillator, etc, Monday, July 15.

9. Statistical thermodynamics - Interdependence of quantum mechanics and thermodynamics, partition functions; Wednesday, July 17, 1974.

10. Statistical thermodynamics - Calculating thermodynamic functions and heat capacities from spectra, comparison with experiment; Monday, July 22, 1974.

11. Light scattering - Why the sky is blue, Rayleigh's contribution, Einstein's 1910 work, polymer solutions; Monday, July 29, 1974

12. Light scattering - Doppler broadening, Brillouin scattering, Rayleigh line broadening, kinetics; Thursday, August 1, 1974.

Lecturer: John L. Lundberg

Appendix VI

FIELD TRIPS AND VISITS

A. Off Campus

1. Fernbank Science Center, (Decatur, Georgia) - planetarium show, observation of solar flares and sun spots, meterological observations, discussion and demonstration of cyclonic winds, nature walk, natural history museum, July 19.

2a. American Enka Corporation, Central, S.C. - discussion and inspection of commercial polymerization of caprolactam to make nylon 6, purification and drying of nylon 6, melting and extrusion of filament, attenuation of molten filament, cooling, and application of spin finish to filament, drawing and texturing of nylon filament, July 25.

3b. Oconee Station, Duke Power Company, Seneca, S.C. - discussion and inspection of very large nuclear power plant including two operating reactors, steam boilers, turbines, generators, lakes and dams for hydroelectric storage of energy, July 25.

FIELD TRIPS AND VISITS

B. On the Georgia Tech Campus:

1. School of Ceramic Engineering - Ceramic materials and glass making demonstrated; July 17.
2. Georgia Tech Library - Facilities and services of library, computer searching, keys to the literature, "how to" resources, etc described and demonstrated in some detail. June 18.
3. School of Physics - Holography and ionic beams demonstrated; June 18.
4. School of Chemistry - Enzyme research, nuclear magnetic resonance, and crystallography demonstrated; June 18.
5. Georgia Tech Engineering Experiment Station - Electron microscopy (TEM,SEM, and diffraction), X-ray fluorescence spectroscopy, and micromechanics laboratory demonstrated, June 19.
6. School of Electrical Engineering - Modulation of lasers and interactive computer development described and shown, June 19.
7. School of Nuclear Engineering and the Georgia Tech Nuclear Reactor - Use of radiation in research and boiling water reactor demonstrated, June 19.
8. Georgia Tech Computer Center - Use of Univac 1108 and PDP8 computers and plotter described and demonstrated, user facilities and procedures shown in detail. June 20.

Appendix VII

PARTIAL LIST OF SCIENCE MOVIES SHOWN, 1974 NSF-SSTP

1. UNIVERSE. Solar system, sun, etc.
2. THE BEACH - A RIVER OF SAND: Movement of sand along a shore.
3. CAVITATION: Forms of cavitation and effects in applications.
4. CHANNEL FLOW OF A COMPRESSIBLE FLUID.
5. COSMIC RAYS: Discovery, measurement, and effects of cosmic rays.
6. WHY MAN CREATES: Nature of the creative process.
7. EXPERIMENTS WITH BUBBLE MODEL OF A METAL STRUCTURE.
8. CRYSTALS - AN INTRODUCTION: Structures & properties of crystals.
9. MEMORY DEVICES: Various electrical storage devices.
10. AN APPROACH TO THE PREDICTION OF EARTHQUAKES.
11. EROSION - LEVELLING OF THE LAND: Erosion processes.
12. DOMAINS AND HYSTERESIS IN FERROMAGNETIC MATERIALS: Domain formation, magnetically soft & hard materials.
13. RHEOLOGICAL BEHAVIOR OF FLUIDS: Non-Newtonian flow & normal stresses. (Shown twice)
14. EVIDENCE FOR THE ICE AGE: Landscapes and glaciers.
15. THE FORCE OF GRAVITY: Measurements and viewpoints of gravity.
16. PRINCIPLES OF THE OPTICAL LASER: How lasers work.
17. MAGNETIC FORCE: The earth's magnetic field.
18. MAGNETOHYDRODYNAMICS.
19. ULTIMATE STRUCTURE: Identification and structure of elements & compounds.
20. PHYSICAL CHEMISTRY OF POLYMERS: Structures & properties of polymers. (Shown twice).

21. RADIO WAVES: Nature and use of radio waves.

22. HOW RAYON IS MADE: Viscose and cuproammonium processes.

23. LOW REYNOLDS NUMBERS FLOWS: Inertia-free, viscous flows.

24. BRATTAIN ON SEMICONDUCTOR PHYSICS: Introduction to semiconductors.

25. SILICONES: Development and uses of silicones.

26. SIMILARITIES IN WAVE BEHAVIOR: Mechanical waves, properties.

27. SYMMETRY: Definition and animation of symmetry.

28. TEXTILES 1A: Students do "their thing" in textiles.

Appendix VIII

RECREATIONAL AND GROUP ACTIVITIES

1. "Dutch treat" supper for student participants, parents, friends, and faculty, Lobby, School of Textile Engineering, Sunday, June 16.

2. Visit to High Museum of Art and Underground Atlanta, Saturday, June 22.

3. Visit to Lundberg residence (recreation and supper), Sunday June 30.

4. A day of sports on campus and a visit to Lenox Square in Atlanta for band concerts and fireworks display, Thursday, July 4.

5. Visit to Stone Mountain Park, hiking, swimming, boating, historical museum, train rides, supper, etc., Sunday, July 7.

6. Visit to "Six Flags Over Georgia", amusement park, Sunday, July 14.

7a. Visit to "The Little WhiteHouse", Warm Springs, Georgia, Thursday, July 8.

7b. Visit to Callaway Gardens, conservatory, gardens, swimming, tennis, cycling, water skiing, buffet lunch, etc. Thursday, July 18.

8. Picnic at Lake Keowee, S.C.; swimming at Clemson University YMCA Beach, Lake Hartwell, S.C.; supper at Coneross Fish Lodge, Friendship Township, S.C. (on trip from American Enka Corporation and Duke Power Company), Thursday, July 25.

9. Visit to Lundberg residence (recreation and supper), Sunday, July 28.

10. "Open house", School of Textile Engineering, and last day "convocation" for participants, family, friends and faculty, Friday, August 2.

Appendix IX

NSF-SSTP QUESTIONNAIRE (8/74)

1. There were (too many, too few) lectures during the program.

Too many:	8 (29%)
Too few:	6 (21%)
Right number:	14 (50%)

2. Each lecture on the average was (too short, too long).

Too short:	1 (4%)
Too long:	17 (60%)
Right length:	10 (36%)

3. The ideal length for a lecture in this program would be (1 hr., 1 1/2 hrs, 2 hrs, 2 1/2 hrs, 3 hrs).

1 hour:	16 (57%)	2 1/2 hrs:	0
1 1/2 hrs:	11 (39%)	3 hrs:	0
2 hrs:	0	No opinion:	1 (4%)

4. Lecture material was (always, often, seldom, never) at a level difficult for me to understand.

Always:	0	Never:	4 (14%)
Often:	8 (28%)	No opinion:	1 (4%)
Seldom:	15 (54%)		

5. The lectures that interested me most had as their subjects:

   a. Fibrous structures in the human body (RA Liebelt): 7
   b. Polymer chemistry: 6
   c. Polymer physics: 6
      Weaving: 6
      Thermodynamics: 5
      Ceramics (J.F. Benzel & J.K. Cochran): 5

6. The lectures which were least interesting had as their subjects.

   a. Weaving: 5
   b. Chemical bonding: 5
   c. No opinion: 4
      Knitting: 2
      Thermodynamics: 2
      Kinetics: 2
      Polymers: 2

7. There were (too many, too few) lectures given by people from outside the School of Textile Engineering.

Too many:	0
Too few:	20 (71%)
Right number:	8 (29%)

8. There was (too little, too much) material covered during the seven week period.

Too little:	9 (32%)
Too much:	1 (4%)
Right amount:	18 (64%)

9. There were (too many, too few) research topics from which to choose.

Too many:	2 (7%)
Too few:	9 (32%)
Right number:	17 (61%)

10. Faculty assistance on my research topic was (excellent, good, fair, poor).

Excellent:	16 (57%)	Poor:	1 (4%)
Good:	6 (21%)	No opinion:	2 (7%)
Fair:	3 (11%)		

11. Materials and instruments needed to carry out my research were (easy, difficult) to obtain.

Easy:	17 (61%)	Difficult:	11 (39%)

12. (More, Less) time should have been allotted for research.

More time:	8 (29%)
Less time:	2 (7%)
Right time:	18 (64%)

13. (More, Less) time should have been devoted to familiarizing me with Tech's research facilities.

More:	11 (39%)	Right time:	15 (54%)
Less:	2 (7%)		

Specifically:
- Other schools: 4
- Computers: 2
- Textile labs: 2
- Chemistry labs: 1
- High temperature facilities: 1

14. (More, Less) time should have been devoted to familiarizing me with Tech's recreational activities.

More: 10 (36%) Right time: 18 (64%)
Less: 0
Specifically:
Gymnasium facilities: 3
Swimming pools: 3
Church centers for students: 1

15. There were (too many, too few) organized outings.

Too many: 3 (11%)
Too few: 9 (32%)
Right number: 16 (57%)

16. The outing I enjoyed most was:

Six Flags Over Georgia:	12
American Enka Corp:	8
Duke Power Company:	6
Lundberg residence:	5
Lake Hartwell:	3
Stone Mountain:	2
No opinion:	2

17. The outing I enjoyed least was:

Callaway Gardens:	8
Stone Mountain:	4
Little White House:	3
Duke Power Company:	2
Underground Atlanta:	2
American Enka Corporation:	2
No opinion:	8

18. I would like to have had (more, less) free time on weeknights and weekends.

More time: 9 (32%)
Less time: 2 (7%)
Right time: 17 (61%)

19. Had I more free time I would have used it to.

Do research: 5
Visits on Tech campus: 4
Recreation at Tech: 2
Relax: 2
Computing: 2
No opinion: 11

20. I would recommend this program to my fellow students if.

a.	it were run much the same way:	16 (57%)
b.	a few changes were made:	10 (36%)
c.	the following major changes were made:	2 (7%)

Open the program to younger people (freshmen and sophomores): 1
Granting credit for participation: 1

Additional comments:

Complimentary remarks: 24
Have more visiting lecturers: 3
Have more computer seminars: 2
Have late morning seminars: 2
Have more materials for research: 2
Several other comments, each made by one student.